**Question 1** Two vehicles move around a circular track in opposite directions but at constant speeds. The two vehicles start at the same point and meet every 30 seconds. When the two vehicles move in the same direction they meet every 120 seconds (the cars are moving at the same speeds as when they were traveling in opposite directions). If the track is 2 km long, determine the speed of each car in km/h.

Question 2 The points A,B,C,D are located at the ends of the position vectors A,B,C and D which are equal to $i + 2k$, $-i + 2k$, $j + 2k$ and $-j + 2k$ respectively, the lengths being measured in meters. The points A,B,C, D and the origin form a pyramid.

Determine
(a) the angle between A and B
(b) the area of one of the triangular faces of the pyramid
(c) the volume of the pyramid
(d) the unit (position) vector of the centre of the base.

Question 3 The graph below was obtained from a set of data regarding the price of a precious stone in US$ to its size in mm. Label the axes of the graph appropriately and determine the equation that links the price to size. Be sure to give the units of any parameters (constants) in the equation.
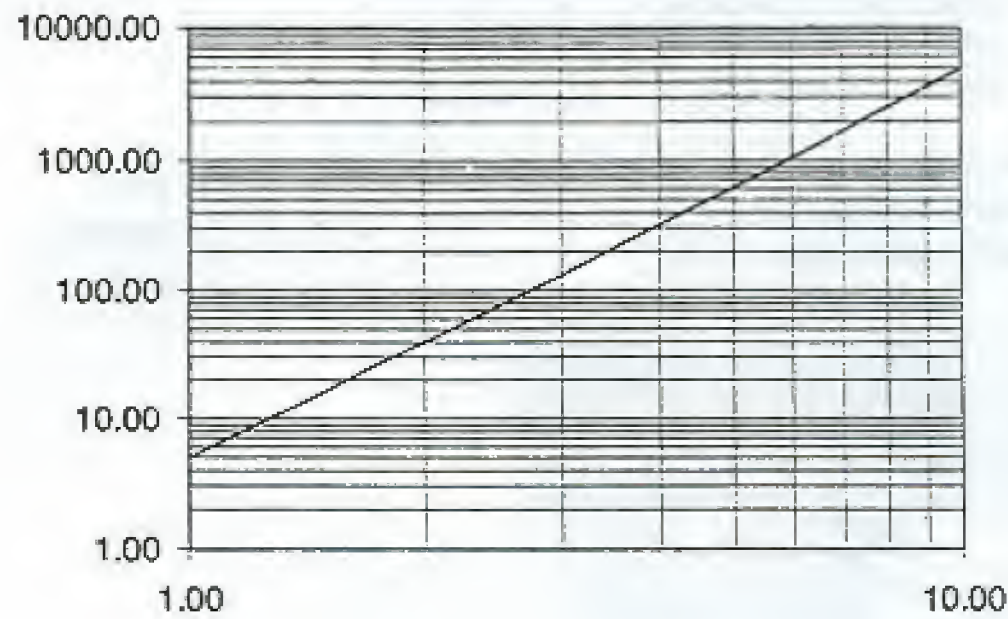
Question 4 A bicycle wheel has a diameter of .7 m and is rotating at 120 rpm.

    (a) What is the angular speed in radians per second?
    (b) How far would the bicycle travel after a rotation of the wheel of 300 radians?
   (c) What will be the velocity of the bicycle in kilometres per hour?

Question 5 The rate of a chemical reaction is strongly dependent upon temperature. The reaction rate parameter, k, is expressed as: $k = Ae^{-(E/R)\lambda}$

where

k	=	the rate parameter, s^{-1}	
A, E	=	constants for the reaction	
R	=	the ideal gas constant = 8.314 J/mol·K	
λ	=	inverse temperature, K^{-1}	

The reaction rate parameter for the decomposition of benzene diazonium chloride is measured at various values of λ and recorded in the table below. Use this information to determine the constants A and E for this reaction. Be sure to state the units of each.

| $\lambda\ (K^{-1})$	$k\ (s^{-1})$
3.19×10^{-3}	0.00043
3.13×10^{-3}	0.00103
3.09×10^{-3}	0.00180
3.05×10^{-3}	0.00355
3.00×10^{-3}	0.00717

(From Fogler, 1992)
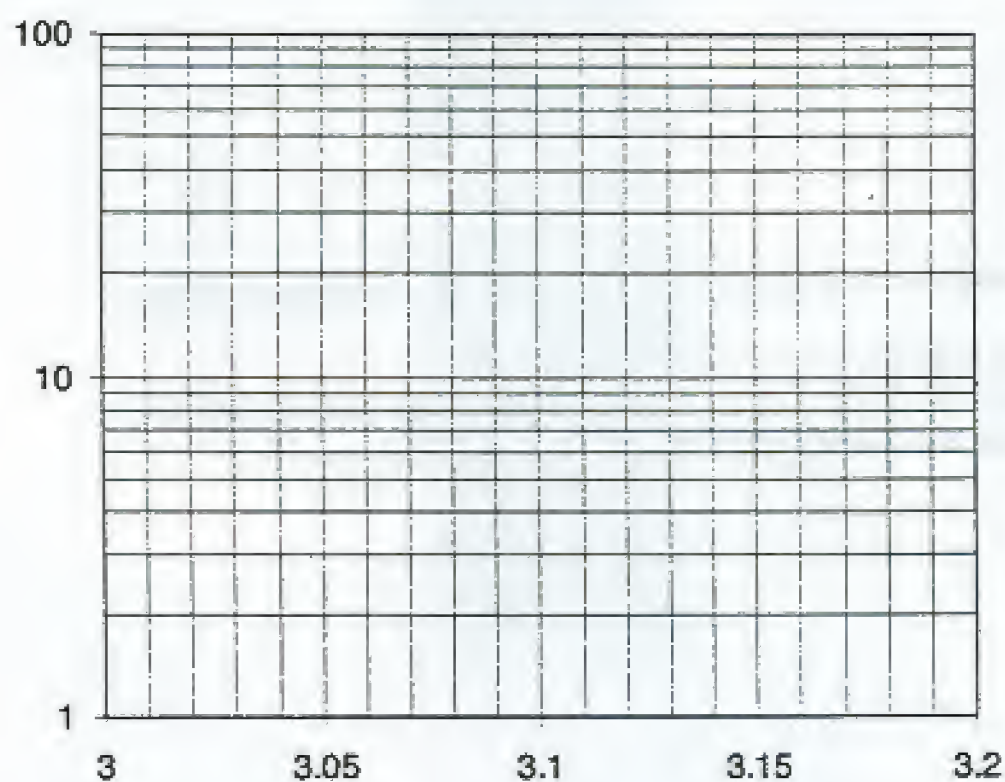
Question 6 In the paper making process, paper is dried by running it over a number of drying cylinders. A section of the drying process is shown below. The centers of the drying cylinders form an equilateral triangle with sides of 2 m. If the paper is moving at 15 m/s, calculate:

a) the time that a piece of paper is in contact with the drying cylinders shown

b) the percentage of time that the paper is on the cylinders between point A and point B

$r_1 = 0.75$ m

$r_2 = 0.5$ m

Direction of Paper Flow, 15 m/s
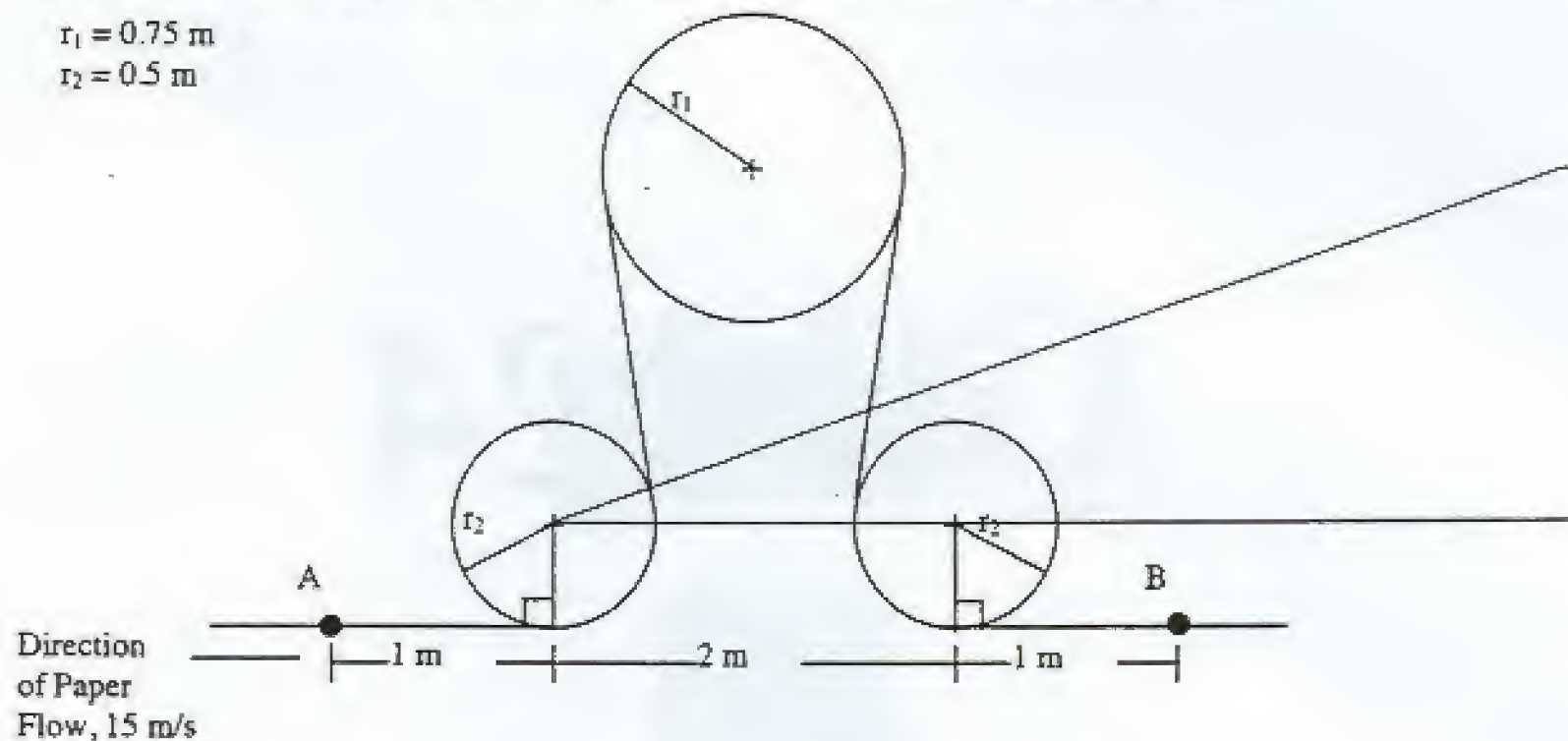
* Since the drawings aren't here (7+8) just know your stuff!

Question 7 Sketch (freehand) the full scale isometric view of the object described in the orthographic views below. Assume the views shown are half scale.

Assuming that the height of the object is 0.1 m, what is the volume of the object?

Question 8 (a) Sketch (freehand) the isometric section of the object shown in the space below the orthograhic view. Marks will be given for the accuracy of the solution **and** the neatness of sketch.

(b) Complete the section in the right hand profile view

Scale: Approximately full scale.